

GENERAL SPECIFICATION

SUBSEA SYSTEMS

GS EP SPS 008

Thermal insulation of subsea stations

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1. Scope

This document provides the requirements for the design, qualification and testing of thermal insulation of subsea modules.

This specification is applicable to all permanently installed subsea equipments which shall be insulated to the extent necessary to fulfil the thermal requirement defined in the project documentation. It covers typically subsea modules (XT, manifold, subsea processing module), valves connectors, instrumentation and well jumper.

It covers all components from subsea modules such as valves (including actuator), sensors, flow spools, retrievable equipment, connector caps and other components on the main subsea assemblies.

The insulation coating and any component contributing to the thermal insulation assembly shall be qualified for the service conditions and life time specified for the project.

Thermal analysis methods and acceptance criteria as presented herein, are subject to Company's approval.

This specification applies for passive insulation only.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

This technical specification is complementary to document **GS EP SPS 001** and shall therefore be read in conjunction with said document and the other Company specifications and standards identified herein.

Thermal insulation requirements for subsea stations are field specific. Consequently, project documentation shall be used in addition to this GS by the contractor to derive the reference fluid properties and specific requirements.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ISO 12736	Petroleum and natural gas industries - Wet thermal insulation coatings for pipelines, flow lines, equipment and subsea structures

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Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP COR 100	Design of cathodic protection of offshore structures
GS EP COR 226	Materials for thermal insulation of pipeline, piping and subsea components
GS EP COR 227	Multi-layer Glass Syntactic PP coating for wet thermal insulation of subsea pipes
GS EP SPS 001	Subsea Production Systems General Design Requirements
GS EP SPS 002	Design of Subsea Stations
GS EP SPS 009	Corrosion protection of subsea stations

3. Definitions and Abbreviations

The following definitions and abbreviations are used in this specification:

- CA Corrosion Allowance
- CDT Cool Down Test
- CFD Computational Fluid Dynamics
- Company TOTAL or its nominated representative(s)
- Contractor The Company contracted to perform the work
- DL Dead Leg
- ECT Early Component Test
- EHTC External Heat Transfer Coefficient
- FAT Factory Acceptance Test
- FEA Finite Element Analysis
- GOR Gas Oil Ratio
- GS General Specification
- HET Hydrates Equilibrium Temperature
By definition, correspond to the hydrates dissociation temperature
- HSE Health Safety and Environment
- HTC Heat Transfer Coefficient
- ID Internal Diameter
- IHTC Internal Heat Transfer Coefficient

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- ISO International Standardization Organization
- MHV Manifold Header Valve
- MPFM MultiPhase Flow Meter
- MPP MultiPhase Pump
- MPV Manifold Production Valve
- OD Outer Diameter
- OHTC Overall Heat Transfer Coefficient. By definition, ID based
- PMV Production Master Valve
- PSV Production Swab Valve
- PWV Production Wing Valve
- ROV Remote Operated Vehicle
- SPS Subsea Production System
- System Combination of Units serving a particular function or functions
- U-value By definition, refer to the OHTC without considering IHTC & EHTC
- Unit Individual equipment item
- WAT Wax Appearance Temperature
- WC Water Cut
- XT Christmas Tree

The following dimensionless numbers are used in this specification:

- $Bi = \frac{hL}{k}$ Biot number
- $Fo = \frac{kt}{\rho C_p L^2}$ Fourier number
- $Gr = \frac{\rho^2 g \beta \Delta T L^3}{\mu^2}$ Grashof number
- $Nu = \frac{hL}{k}$ Nusselt number
- $Pr = \frac{\mu C_p}{k}$ Prandtl number
- $Ra = Gr Pr$ Rayleigh number
- $Re = \frac{\rho V D}{\mu}$ Reynolds number

4. Responsibility

It is the responsibility of the equipment supplier to ensure and document compliance with the requirements defined in this specification, and other relevant standards and statutory requirements.

Deviations from any of the requirements defined herein shall be treated as non-conformance in accordance with relevant Company procedures.

5. Thermal Performance Requirements

5.1 Steady State

5.1.1 Thermal requirement for flowing conditions

For jumpers, the Overall Heat Transfer Coefficient (OHTC) shall meet the specified value given in the project documentation, to avoid relatively high heat loss from the well head up to the header. This OHTC is a minimum thermal requirement (i.e. maximum values). The cool down time specifications may lead to more stringent conditions.

When a wax deposition risk is identified, the wall temperature in flowing conditions shall stay above the WAT.

5.1.2 Thermal requirement for dead leg configurations

Stagnant production fluid (dead leg) shall remain above the HET during steady state conditions. The HET is defined in the project requirements as a function of the pressure. All dead legs (in blue in the figures below) shall be considered, like main bore dead leg (for example for closed branch on manifold), but also small bore (for example between tee connection on main bore up to injection valve).

Unless otherwise stipulated in the project requirement, the most constraining production turn-down configuration leading to the longest dead leg shall be considered (as illustrated below).

Figure 1 - Main bore dead leg example on a 6 slots, double header manifold

